

LISTING OF CLAIMS

As our invention, we claim:

1. (Canceled)
2. (Previously allowed and Currently amended) An apparatus for collecting and reducing yard debris comprising:
 - a. a frame adapted for movement in a principal direction upon a surface;
 - b. a first duct mounted on said frame having an entrance and an exit;
 - c. a collector rotor assembly comprising: a collector rotor body disposed at the entrance to said first duct having a substantially horizontal axis of rotation generally normal to said first direction; and a plurality of impeller elements mounted upon said collector rotor body, said impeller elements being adapted to:
 - i. engage and sweep over said surface,
 - ii. collect yard debris thereupon, and
 - iii. impel said yard debris toward said duct entrance,said impeller elements extending radially from said collector rotor body by at least about one quarter of an inch;said collector rotor assembly and said first duct being configured for substantially untrammed frontal engagement with yard debris having a depth of at least about two (2) inches;

- d. a second duct having an entrance and an exit;
 - e. a ~~shredder~~ blower unit, disposed between said exit to said first duct and said entrance to said second duct, adapted to:
 - i. provide suction at said entrance of said first duct,
 - ii. induce a flow of air through said first and second ducts, and
 - iii. reduce yard debris entrained in said flow of air as it passes through said ~~shredder~~-blower unit;
 - f. an air-solids separator disposed at said exit to said second duct for separating said reduced yard debris in said flow of air induced by said ~~shredder~~-blower into a debris-enriched stream and a debris-depleted stream;
 - g. means for discharging said debris-depleted stream to the atmosphere;
 - h. an accumulator operatively connected to said air-solids separator and adapted to receive said debris-enriched stream from said air-solids separator;
 - i. means operatively connected to said ~~shredder~~-blower unit and adapted to provide power to said ~~shredder~~-blower unit; and
 - j. means operatively connected to said collector rotor assembly and adapted to provide power to said collector rotor assembly.
3. (Previously allowed) The apparatus of claim 2 wherein said impeller elements extend radially at least about an inch from said collector rotor body.
4. (Previously allowed) The apparatus of claim 2 wherein said collector rotor assembly comprises a substantially gas-impervious impediment to unrestricted flow

of air into said first duct and extends substantially athwart said entrance to said first duct.

5. (Canceled) The apparatus of claim 2 wherein said collector rotor assembly comprises three impeller elements generally equispaced around said collector rotor body.
6. (Previously allowed and Currently Amended) The apparatus of claim 4 wherein said collector rotor assembly further comprises fillets~~means~~ extending between adjacent impeller elements for limiting carriage of yard debris around said collector rotor assembly, wherein said fillets~~means~~ partially define generally concentric interrupted annular cavity spaces between adjacent impeller elements.
7. (Previously allowed and Currently amended) The apparatus of claim 2 further comprising a housing ~~means for limiting~~ adapted to limit the flow of air between said housing ~~means~~ and said collector rotor assembly without substantially impeding air flow along said surface under said collector rotor assembly and into said entrance of said first duct, said housing ~~means~~:
 - a. being disposed above said collector rotor assembly,
 - b. engaging each of said impeller element tips in flow-limiting proximity seriatim, and
 - c. being configured to permit substantially untrammelled frontal engagement of said collector rotor assembly with said yard debris having a depth of at least about two (2) inches.

8. (Previously allowed and Currently amended) The apparatus of claim [[7]]2 further comprising vertically extending seals~~means~~ carried on said frame adjacent to the ends of said collector rotor assembly for limiting axial flow of air flow into said collector rotor assembly.
9. (Previously allowed and Currently amended) The apparatus of claim [[7]]2 further comprising vertically extending seals~~means~~ carried on the ends of said collector rotor assembly for limiting axial flow of air into said collector rotor assembly.
10. (Previously allowed and Currently amended) The apparatus of claim 7 wherein said housing ~~means~~ defines a frontal opening extending from said surface vertically to a height of at least four inches and a suction opening under said rotor extending rearwardly from the front of said apparatus at least to a line below said axis of rotation of said collector rotor body.
11. (Previously allowed) The apparatus of claim 7 wherein said impeller elements mounted on said collector rotor body are configured to allow intermittent rearward rushes of air under the forward side of said rotating rotor body into said entrance to said first duct, and pulsed forward rushes of air under said first duct and into said first duct entrance, thereby alternately collecting principally bulky yard debris from said forward side of said rotor body during said rearward rushes of air and enhancing collection of residual debris from said surface during said pulsed forward rushes of air.
12. (Previously allowed and Currently amended) The apparatus of claim 7 further comprising an air-slot ~~means~~ defined within said housing ~~means~~ between the upper lip of said housing ~~means~~ and said entrance to said first duct for allowing flow of air

in a direction opposed to the direction of rotation of said collector rotor body and into said first duct and stripping leaves and debris from said rotating rotor assembly.

13. (Previously allowed) The apparatus of claim 2 wherein said entrance to said first duct generally spans the length of said collector rotor body and said first duct converges rearwardly such that the convergence angle throughout the duct is generally less than 100 degrees.

14. (Previously allowed and Currently amended) The apparatus of claim 2 wherein said air-solids separator ~~means~~ comprises:

- a. a first passage for accepting said flow of air bearing entrained reduced yard debris from said second duct;
- b. a separation chamber adapted to receive said flow of air from said first passage;
- c. a second passage adapted to exhaust said debris-depleted stream from said separation chamber into the atmosphere; and
- d. a baffle ~~means~~ for:
 - i. generally inhibiting secondary flow from said ~~accumulation~~
~~means~~accumulator; and
 - ii. impeding re-entrainment of fine particulates in said debris-depleted stream as it is discharged to the atmosphere;

said baffle being disposed between said separation chamber and said

~~accumulation chamber~~accumulator; and

said baffle being disposed to permit passage of entrained reduced yard debris

into said accumulator while impeding passage of fine particulates of reduced yard debris in air exhausted from said separation chamber through said second passage.

15. – 18. (Canceled)

19. (Previously allowed and Currently amended) The apparatus of claim 2 wherein the tips of said impeller elements further comprise ~~means for engaging an undulating surface, including pliable blades adapted for engaging an undulating surface, said pliable blades~~ being yieldable to hard objects encountered on said surface, but being sufficiently stiff to sweep debris from undulations present in said surface.

20. (Previously allowed) The apparatus of claim 2 wherein the tips of said impeller elements comprise rows of radially-extending raker teeth adapted to engage and impel debris objects on said surface toward said entrance of said first duct.

21. – 23. (Canceled)

24. (Previously allowed) The apparatus of claim 2 wherein the cross-sectional area of the channel through said first duct measured normal to the center flow line of said airflow through said first duct remains generally constant along said center flow line.

25. (Previously allowed) The apparatus of claim 2 further comprising a lawnmower mounted on said frame wherein said collector rotor assembly is disposed along the advancing front of said lawnmower, and said entrance of said first duct is operatively connected to said lawnmower to receive said yard debris.

26. (Previously allowed and Currently amended) The apparatus of claim 25 wherein said collector rotor assembly impels said yard debris into the mowing chamber

within the mowing enclosure of said lawnmower, and said entrance of said first duct receives said yard debris from [[the]]a discharge opening of said mowing enclosure.

27. – 39. (Canceled)

40. (Previously allowed) The apparatus of claim 2 further comprising at least one adjustable-height roller adjacent said collector rotor assembly adapted for supporting said collector rotor assembly at adjustable heights above said surface whereby the degree of engagement of said impeller elements with said surface may be controlled.

41. (Previously allowed) The apparatus of claim 2 wherein said collector rotor assembly is adapted to rotate with an impeller tip velocity of at least about three miles per hour.

42. (Previously allowed and Currently amended) An apparatus for collecting and reducing yard debris comprising:

- a. a frame adapted for movement in a principal direction upon a surface;
- b. a first duct mounted on said frame having an entrance and an exit;
- c. a collector rotor assembly comprising: a collector rotor body disposed at the entrance to said first duct having a substantially horizontal axis of rotation generally normal to said first direction; and a plurality of impeller elements mounted upon said collector rotor body, said impeller elements being adapted to:
 - i. sweep over said surface,
 - ii. collect yard debris thereupon, and
 - iii. impel said yard debris toward said duct entrance,

- said impeller elements extending radially from said collector rotor body by at least about one quarter of an inch;
- said collector rotor assembly further comprising fillets ~~means~~ extending between adjacent impeller elements for limiting carriage of yard debris around said collector rotor assembly;
- said collector rotor assembly and said first duct being configured for substantially untrammelled frontal engagement with yard debris having a depth of at least about two (2) inches;
- d. a second duct having an entrance and an exit;
- e. a shredder-blower unit, disposed between said exit to said first duct and said entrance to said second duct, adapted to:
- i. provide suction at said entrance of said first duct,
 - ii. induce a flow of air through said first and second ducts, and
 - iii. reduce said yard debris entrained in said flow of air as it passes through said shredder-blower unit;
- f. an air-solids separator ~~means~~ disposed at said exit to said second duct for separating said reduced yard debris in said flow of air induced by said shredder-blower into a debris-enriched stream and a debris-depleted stream;
- g. an ~~accumulation means~~ accumulator operatively connected to said air-solids separator and adapted to receive said debris-enriched stream from said air-solids separator;

h. means operatively connected to said ~~shredder~~-blower unit and adapted to provide power to said ~~shredder~~-blower unit; and

i. means operatively connected to said collector rotor assembly and adapted to provide power to said collector rotor.

43. (Previously allowed and Currently amended) The apparatus of claim 42 wherein said fillets ~~means~~ partially define generally concentric interrupted annular cavity spaces between adjacent impeller elements, and wherein the ~~radius~~radii of said fillets ~~means~~ [[is]]are at least about one third of the swing ~~radius~~radii of the tips of said impeller elements mounted upon said collector rotor body.

44. (Previously allowed and Currently amended) An apparatus for collecting and reducing yard debris comprising:

- a. a frame adapted for movement in a principal direction upon a surface;
- b. a first duct mounted on said frame having an entrance and an exit;
- c. a collector rotor assembly comprising: a collector rotor body disposed at the entrance to said first duct having a substantially horizontal axis of rotation generally normal to said first direction; and a plurality of impeller elements mounted upon said collector rotor body, said impeller elements being adapted to:
 - i. sweep over said surface,
 - ii. collect yard debris thereupon, and
 - iii. impel said yard debris toward said duct entrance,

- said impeller elements extending radially from said collector rotor body by at least about one quarter of an inch;
- said collector rotor assembly and said first duct being configured for substantially untrammed frontal engagement with yard debris having a depth of at least about two (2) inches;
- d. a lawnmower mounted on said frame wherein the collector rotor assembly is disposed along the advancing front of said lawnmower and the entrance of the first duct is operatively connected to said lawnmower to receive said yard debris;
- e. a second duct having an entrance and an exit;
- f. a ~~shredder~~-blower unit, disposed between said exit to said first duct and said entrance to said second duct, adapted to:
- i. provide suction at said entrance of said first duct,
 - ii. induce a flow of air through said first and second ducts, and
 - iii. reduce yard debris entrained in said flow of air as it passes through said ~~shredder~~-blower unit;
- g. an air-solids separator ~~means~~-disposed at said exit to said second duct for separating said reduced yard debris in said flow of air induced by said ~~shredder~~-blower into a debris-enriched stream and a debris-depleted stream;
- h. an accumulation ~~means~~accumulator operatively connected to said air-solids separator and adapted to receive said debris-enriched stream from said air-solids separator;

i. means operatively connected to said ~~shredder~~-blower unit and adapted to provide power to said ~~shredder~~-blower unit; and

k. means operatively connected to said collector rotor assembly and adapted to provide power to said collector rotor.

45. (Previously allowed and Currently Amended) The apparatus of claim ~~[[41]]~~44 wherein said collector rotor assembly impels said yard debris into the mowing chamber within the mowing enclosure of said lawnmower and said entrance of said first duct receives said yard debris from ~~[[the]]~~a discharge opening of said mowing enclosure.

46. (Previously allowed and Currently Amended) An apparatus for collecting and reducing yard debris comprising:

- a. a frame adapted for movement in a principal direction upon a surface;
- b. a first duct mounted on said frame having an entrance and an exit;
- c. a collector rotor assembly comprising: a collector rotor body disposed at the entrance to said first duct having a substantially horizontal axis of rotation generally normal to said first direction; and a plurality of impeller elements mounted upon said collector rotor body, said impeller elements being adapted to:
 - i. sweep over said surface,
 - ii. collect yard debris thereupon, and
 - iii. impel said yard debris toward said duct entrance,

said impeller elements extending radially from said collector rotor body by at least about one quarter of an inch;

wherein said collector rotor assembly comprises a substantially gas-impervious impediment extending substantially athwart said entrance to said first duct to direct flow of air along said surface into said first duct; and said collector rotor assembly and said first duct being configured for substantially untrammelled frontal engagement with yard debris having a depth of at least about two (2) inches;

- d. a second duct having an entrance and an exit;
- e. a shredder-blower unit, disposed between said exit to said first duct and said entrance to said second duct, adapted to:
 - i. provide suction at said entrance of said first duct,
 - ii. induce a flow of air through said first and second ducts, and
 - iii. reduce yard debris entrained in said flow of air as it passes through said shredder-blower unit;
- f. an air-solids separator means-disposed at said exit to said second duct for separating said reduced yard debris in said flow of air induced by said shredder-blower into a debris-enriched stream and a debris-depleted stream;
- g. an ~~accumulation means~~accumulator operatively connected to said air-solids separator and adapted to receive said debris-enriched stream from said air-solids separator;

h. means operatively connected to said ~~shredder~~-blower unit and adapted to provide power to said ~~shredder~~-blower unit; and

i. means operatively connected to said collector rotor assembly and adapted to provide power to said collector rotor.

47. (Previously allowed and Currently Amended) The apparatus in claim 46 further comprising a housing ~~means for limiting~~adapted to limit the flow of air between said housing ~~means~~ and said collector rotor assembly without substantially impeding air flow along said surface under said collector rotor assembly and into said entrance of said first duct, said housing ~~means~~:

- a. being disposed above said collector rotor assembly,
- b. engaging each of said impeller element tips in flow-limiting proximity seriatim, and
- c. being configured to permit substantially untrammelled frontal engagement of said collector rotor assembly with said yard debris having a depth of at least about two (2) inches.

48. (Previously allowed and Currently Amended) An apparatus for collecting and reducing yard debris comprising:

- a. a frame adapted for movement in a principal direction upon a surface;
- b. a first duct mounted on said frame having an entrance and an exit;
- c. a collector rotor assembly comprising: a collector rotor body disposed at the entrance to said first duct having a substantially horizontal axis of rotation generally normal to said first direction; and a plurality of impeller elements

mounted upon said collector rotor body, said impeller elements being adapted to:

- i. sweep over said surface,
- ii. collect yard debris thereupon, and
- iii. impel said yard debris toward said duct entrance,

said impeller elements extending radially from said collector rotor body by at least about one quarter of an inch;

said collector rotor assembly and said first duct being configured for substantially untrammed frontal engagement with yard debris having a depth of at least about two (2) inches;

d. a second duct having an entrance and an exit;

e. a ~~shredder~~-blower unit, disposed between said exit to said first duct and said entrance to said second duct, adapted to:

- i. provide suction at said entrance of said first duct,
- ii. induce a flow of air through said first and second ducts, and
- iii. reduce yard debris entrained in said flow of air as it passes through said ~~shredder~~-blower unit;

f. an air-solids separator ~~means~~-disposed at said exit to said second duct for separating said reduced yard debris in said flow of air induced by said ~~shredder~~-blower into a debris-enriched stream and a debris-depleted stream;

- g. an ~~accumulation means~~accumulator operatively connected to said air-solids separator and adapted to receive said debris-enriched stream from said air-solids separator;
- h. means operatively connected to said ~~shredder~~-blower unit and adapted to provide power to said ~~shredder~~-blower unit; and
- i. means operatively connected to said collector rotor assembly and adapted to provide power to said collector rotor;
wherein said collector rotor assembly is adapted to rotate with an impeller tip velocity of at least about three miles per hour.

49. (Previously allowed and Currently Amended) An apparatus for collecting and reducing yard debris comprising:

- a. a frame adapted for movement in a principal direction upon a surface;
- b. a first duct mounted on said frame having an entrance and an exit;
- c. a collector rotor assembly comprising: a collector rotor body disposed at the entrance to said first duct having a substantially horizontal axis of rotation generally normal to said first direction; and a plurality of impeller elements mounted upon said collector rotor body, said impeller elements being adapted to:
 - i. sweep over said surface,
 - ii. collect yard debris thereupon, and
 - iii. impel said yard debris toward said duct entrance,

said impeller elements extending radially from said collector rotor body by at least about one quarter of an inch;

said collector rotor assembly and said first duct being configured for substantially untrammed frontal engagement with yard debris having a depth of at least about two (2) inches;

- d. a second duct having an entrance and an exit;
- e. a shredder-blower unit, disposed between said exit to said first duct and said entrance to said second duct, adapted to:
 - i. provide suction at said entrance of said first duct,
 - ii. induce a flow of air through said first and second ducts, and
 - iii. reduce yard debris entrained in said flow of air as it passes through said shredder-blower unit;
- f. an air-solids separator means-disposed at said exit to said second duct for separating said reduced yard debris in said flow of air induced by said shredder-blower into a debris-enriched stream and a debris-depleted stream;
- g. an ~~accumulation means~~accumulator operatively connected to said air-solids separator and adapted to receive said debris-enriched stream from said air-solids separator;
said air-solids separator and said accumulator ~~means comprising~~having a baffle ~~means-disposed between said separation chamber~~air-solids separator and said ~~accumulation chamber~~accumulator for:

- i. generally inhibiting secondary flow from said ~~accumulation~~
~~means~~accumulator, and
 - ii. impeding re-entrainment of fine particulates in said debris-depleted stream as it is discharged to the atmosphere;
 - h. means operatively connected to said ~~shredder~~-blower unit and adapted to provide power to said ~~shredder~~-blower unit; and
 - i. means operatively connected to said collector rotor assembly and adapted to provide power to said collector rotor.
50. (New) The apparatus of claim 2 wherein said first duct converges between said duct entrance and said duct exit.
51. (New) The apparatus of claim 2 wherein said entrance of said first duct generally spans the length of said collector rotor body.
52. (New) The apparatus of claim 2 wherein said entrance of said first duct generally spans the collective width of said impeller elements.
53. (New) The apparatus of claim 2 wherein said first duct has a convergence angle of less than about 120°.
54. (New) The apparatus of claim 2 wherein said air-solids separator comprises a free-flow apparatus for separating said lawn debris from said flow of air by action of body forces thereupon.
55. (New) An apparatus for collecting and reducing yard debris comprising:
- a. a frame adapted for movement in a principal direction upon a surface;

- b. a converging duct mounted on said frame having an entrance and an exit;
- c. a collector rotor assembly comprising: a collector rotor body disposed at the entrance to said converging duct having a substantially horizontal axis of rotation generally normal to said first direction; and a plurality of impeller elements mounted upon said collector rotor body, said impeller elements being adapted to:
 - i. engage and sweep over said surface,
 - ii. collect yard debris thereupon, and
 - iii. impel said yard debris toward said converging duct entrance, said impeller elements extending radially from said collector rotor body by at least about one quarter of an inch; said collector rotor assembly and said converging duct being configured for substantially untrammed frontal engagement with yard debris having a depth of at least about two (2) inches;
- d. a second duct having an entrance and an exit;
- e. a blower unit, disposed between said exit to said converging duct and said entrance to said second duct, adapted to:
 - i. provide suction at said entrance of said converging duct, and
 - ii. induce a flow of air through said converging and second ducts;

- f. an air-solids separator disposed at said exit to said second duct for separating said yard debris in said flow of air induced by said blower into a debris-enriched stream and a debris-depleted stream;
 - g. means for discharging said debris-depleted stream to the atmosphere;
 - h. an accumulator operatively connected to said air-solids separator and adapted to receive said debris-enriched stream from said air-solids separator;
 - i. means operatively connected to said blower unit and adapted to provide power to said blower unit; and
 - j. means operatively connected to said collector rotor assembly and adapted to provide power to said collector rotor assembly.
56. (New) The apparatus of claim 55 wherein said converging duct converges from said duct entrance to said duct exit.
57. (New) The apparatus of claim 55 wherein said entrance of said converging duct generally spans the collective width of said impeller elements.
58. (New) The apparatus of claim 55 wherein said converging duct has generally equal cross-sectional area along its length.
59. (New) The apparatus of claim 55 wherein said air-solids separator comprises a free-flow apparatus for separating said yard debris from said flow of air by action of body forces thereupon.
60. (New) An apparatus for collecting and reducing yard debris comprising:
- a. a frame adapted for movement in a principal direction upon a surface;

- b. a converging duct mounted on said frame having an entrance and an exit;
 - c. a second duct having an entrance and an exit;
 - d. a blower unit, disposed between said exit to said converging duct and said entrance to said second duct, adapted to:
 - i. provide suction at said entrance of said converging duct, and
 - ii. induce a flow of air through said converging and second ducts,said converging duct having a convergence angle of less than about 120°;
 - e. a collector rotor assembly comprising: a collector rotor body disposed at said entrance to said converging duct having a plurality of impeller elements mounted upon said collector rotor body, said impeller elements being adapted to:
 - i. engage and sweep over said surface,
 - ii. collect yard debris thereupon, and
 - iii. impel said yard debris toward said entrance to said converging duct,said impeller elements extending from said collector rotor body by at least about one quarter of an inch;
- said collector rotor assembly and said converging duct being configured for substantially untrammed frontal engagement with yard debris having a depth of at least about two (2) inches;

- f. an air-solids separator disposed at said exit to said second duct for separating said yard debris in said flow of air induced by said blower into a debris-enriched stream and a debris-depleted stream;
- g. means for discharging said debris-depleted stream to the atmosphere;
- h. an accumulator operatively connected to said air-solids separator and adapted to receive said debris-enriched stream from said air-solids separator;
- i. means operatively connected to said blower unit and adapted to provide power to said blower unit; and
- j. means operatively connected to said collector rotor assembly and adapted to provide power to said collector rotor assembly.